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<p>This handbook for the port of Taormina, one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.</p>					
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Contractor Report CR 89-10 June 1989

SEVERE WEATHER GUIDE MEDITERRANEAN PORTS

31. TAORMINA

by R. E. Engelbreitson and
R. D. Gilmore.

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Don Jacobs 87

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FOREWORD

This handbook on Mediterranean Ports was developed as part of an ongoing effort at the Naval Environmental Prediction Research Facility to create products for direct application to Fleet operations. The research was conducted in response to Commander Naval Oceanography Command (COMNAVOCEANCOM) requirements validated by the Chief of Naval Operations (OP-096).

As mentioned in the preface, the Mediterranean region is unique in that several areas exist where local winds can cause dangerous operating conditions. This handbook will provide the ship's captain with assistance in making decisions regarding the disposition of his ship when heavy winds and seas are encountered or forecast at various port locations.

Readers are urged to submit comments, suggestions for changes, deletions and/or additions to Naval Oceanography Command Center (NAVOCEANCOMCEN), Rota with a copy to the oceanographer, COMSIXTHFLT. They will then be passed on to the Naval Environmental Prediction Research Facility for review and incorporation as appropriate. This document will be a dynamic one, changing and improving as more and better information is obtained.

W. L. SHUTT
Commander, U.S. Navy

PORT INDEX

The following is a tentative prioritized list of Mediterranean Ports to be evaluated during the five-year period 1988-92, with ports grouped by expected year of the port study's publication. This list is subject to change as dictated by circumstances and periodic review.

1988 NO.	PORT	1990	PORT
1	GAETA, ITALY		TARANTO, ITALY
2	NAPLES, ITALY		ALEXANDRIA, EGYPT
3	CATANIA, ITALY		PORT SAID, EGYPT
4	AUGUSTA BAY, ITALY		ANTALYA, TURKEY
5	CAGLIARI, ITALY		ISKENDERUN, TURKEY
6	LA MADDALENA, ITALY		IZMIR, TURKEY
7	MARSEILLE, FRANCE		GOLCUK, TURKEY
8	TOULON, FRANCE		ISTANBUL, TURKEY
9	VILLEFRANCHE, FRANCE		
10	MALAGA, SPAIN		
11	NICE, FRANCE		
12	CANNES, FRANCE	1991	PORT
13	MONACO		
14	ASHDOD, ISRAEL		ROTA, SPAIN
15	HAIFA, ISRAEL		TANGIER, MOROCCO
16	BARCELONA, SPAIN		ALGIERS, ALGERIA
17	PALMA, SPAIN		TUNIS, TUNISIA
18	IBIZA, SPAIN		BIZERTE, TUNISIA
19	POLLENSA BAY, SPAIN		SFAX, TUNISIA
20	LIVORNO, ITALY		VALETTA, MALTA
21	LA SPEZIA, ITALY		
22	VENICE, ITALY	1992	PORT
23	TRIESTE, ITALY		
24	CARTAGENA, SPAIN		SOUDA BAY, CRETE
25	VALENCIA, SPAIN		PIRAEUS, GREECE
			KALAMATA, GREECE
			THESSALONIKI, GREECE
			CORFU, GREECE
			KITHIRA, GREECE
			LARNACA, CYPRUS
			DUBROVNIK, YUGOSLAVIA
			SPLIT, YUGOSLAVIA
			GULF OF SOLLUM
1989	PORT		
26	SAN REMO, ITALY		
27	GENOA, ITALY		
28	PORTO TORRES, ITALY		
29	PALERMO, ITALY		
30	MESSINA, ITALY		
31	TAORMINA, ITALY		
	BENIDORM, SPAIN		

PREFACE

Environmental phenomena such as strong winds, high waves, restrictions to visibility and thunderstorms can be hazardous to critical Fleet operations. The cause and effect of several of these phenomena are unique to the Mediterranean region and some prior knowledge of their characteristics would be helpful to ship's captains. The intent of this publication is to provide guidance to the captains for assistance in decision making.

The Mediterranean Sea region is an area where complicated topographical features influence weather patterns. Katabatic winds will flow through restricted mountain gaps or valleys and, as a result of the venturi effect, strengthen to storm intensity in a short period of time. As these winds exit and flow over port regions and coastal areas, anchored ships with large 'sail areas' may be blown aground. Also, hazardous sea state conditions are created, posing a danger for small boats ferrying personnel to and from port. At the same time, adjacent areas may be relatively calm. A glance at current weather charts may not always reveal the causes for these local effects which vary drastically from point to point.

Because of the irregular coast line and numerous islands in the Mediterranean, swell can be refracted around such barriers and come from directions which vary greatly with the wind. Anchored ships may experience winds and seas from one direction and swell from a different direction. These conditions can be extremely hazardous for tendered vessels. Moderate to heavy swell may also propagate outward in advance of a storm resulting in uncomfortable and sometimes dangerous conditions, especially during tending, refueling and boating operations.

This handbook addresses the various weather conditions, their local cause and effect and suggests some evasive action to be taken if necessary. Most of the major ports in the Mediterranean will be covered in the handbook. A priority list, established by the Sixth Fleet, exists for the port studies conducted and this list will be followed as closely as possible in terms of scheduling publications.

RECORD OF CHANGES

[illegible]

1. GENERAL GUIDANCE

1.1 DESIGN

This handbook is designed to provide ship captains with a ready reference on hazardous weather and wave conditions in selected Mediterranean harbors. Section 2, the captain's summary, is an abbreviated version of section 3, the general information section intended for staff planners and meteorologists. Once section 3 has been read, it is not necessary to read section 2.

1.1.1 Objectives

The basic objective is to provide ship captains with a concise reference of hazards to ship activities that are caused by environmental conditions in various Mediterranean harbors, and to offer suggestions for precautionary and/or evasive actions. A secondary objective is to provide adequate background information on such hazards so that operational forecasters, or other interested parties, can quickly gain the local knowledge that is necessary to ensure high quality forecasts.

1.1.2 Approach

Information on harbor conditions and hazards was accumulated in the following manner:

- A. A literature search for reference material was performed.
- B. Cruise reports were reviewed.
- C. Navy personnel with current or previous area experience were interviewed.
- D. A preliminary report was developed which included questions on various local conditions in specific harbors.
- E. Port/harbor visits were made by NEPRF personnel; considerable information was obtained through interviews with local pilots, tug masters, etc; and local reference material was obtained.
- F. The cumulative information was reviewed, combined, and condensed for harbor studies.

1.1.3 Organization

The Handbook contains two sections for each harbor. The first section summarizes harbor conditions and is intended for use as a quick reference by ship captains, navigators, inport/at sea OOD's, and other interested personnel. This section contains:

- A. a brief narrative summary of environmental hazards,
- B. a table display of vessel location/situation, potential environmental hazard, effect-precautionary/evasion actions, and advance indicators of potential environmental hazards,
- C. local wind wave conditions, and
- D. tables depicting the wave conditions resulting from propagation of deep water swell into the harbor.

The swell propagation information includes percent occurrence, average duration, and the period of maximum wave energy within height ranges of greater than 3.3 feet and greater than 6.6 feet. The details on the generation of sea and swell information are provided in Appendix A.

The second section contains additional details and background information on seasonal hazardous conditions. This section is directed to personnel who have a need for additional insights on environmental hazards and related weather events.

1.2 CONTENTS OF SPECIFIC HARBOR STUDIES

This handbook specifically addresses potential wind and wave related hazards to ships operating in various Mediterranean ports utilized by the U.S. Navy. It does not contain general purpose climatology and/or comprehensive forecast rules for weather conditions of a more benign nature.

The contents are intended for use in both pre-visit planning and in situ problem solving by either mariners or environmentalists. Potential hazards related to both weather and waves are addressed. The oceanographic information includes some rather unique information relating to deep water swell propagating into harbor shallow water areas.

Emphasis is placed on the hazards related to wind, wind waves, and the propagation of deep water swell into the harbor areas. Various vessel locations/situations are considered, including moored, nesting, anchored, arriving/departing, and small boat operations. The potential problems and suggested precautionary/evasive actions for various combinations of environmental threats and vessel location/situation are provided. Local indicators of environmental hazards and possible evasion techniques are summarized for various scenarios.

CAUTIONARY NOTE: In September 1985 Hurricane Gloria raked the Norfolk, VA area while several US Navy ships were anchored on the muddy bottom of Chesapeake Bay. One important fact was revealed during this incident: Most all ships frigate size and larger dragged anchor, some more than others, in winds of over 50 knots. As winds and waves increased, ships 'fell into' the wave troughs, BROADSIDE TO THE WIND and become difficult or impossible to control.

This was a rare instance in which several ships of recent design were exposed to the same storm and much effort was put into the documentation of lessons learned. Chief among these was the suggestion to evade at sea rather than remain anchored at port whenever winds of such intensity were forecast.

2. CAPTAIN'S SUMMARY

The Port of Taormina is located on the east coast of the Italian island of Sicily at approximately 37°50'N 15°16'E (Figure 2-1).

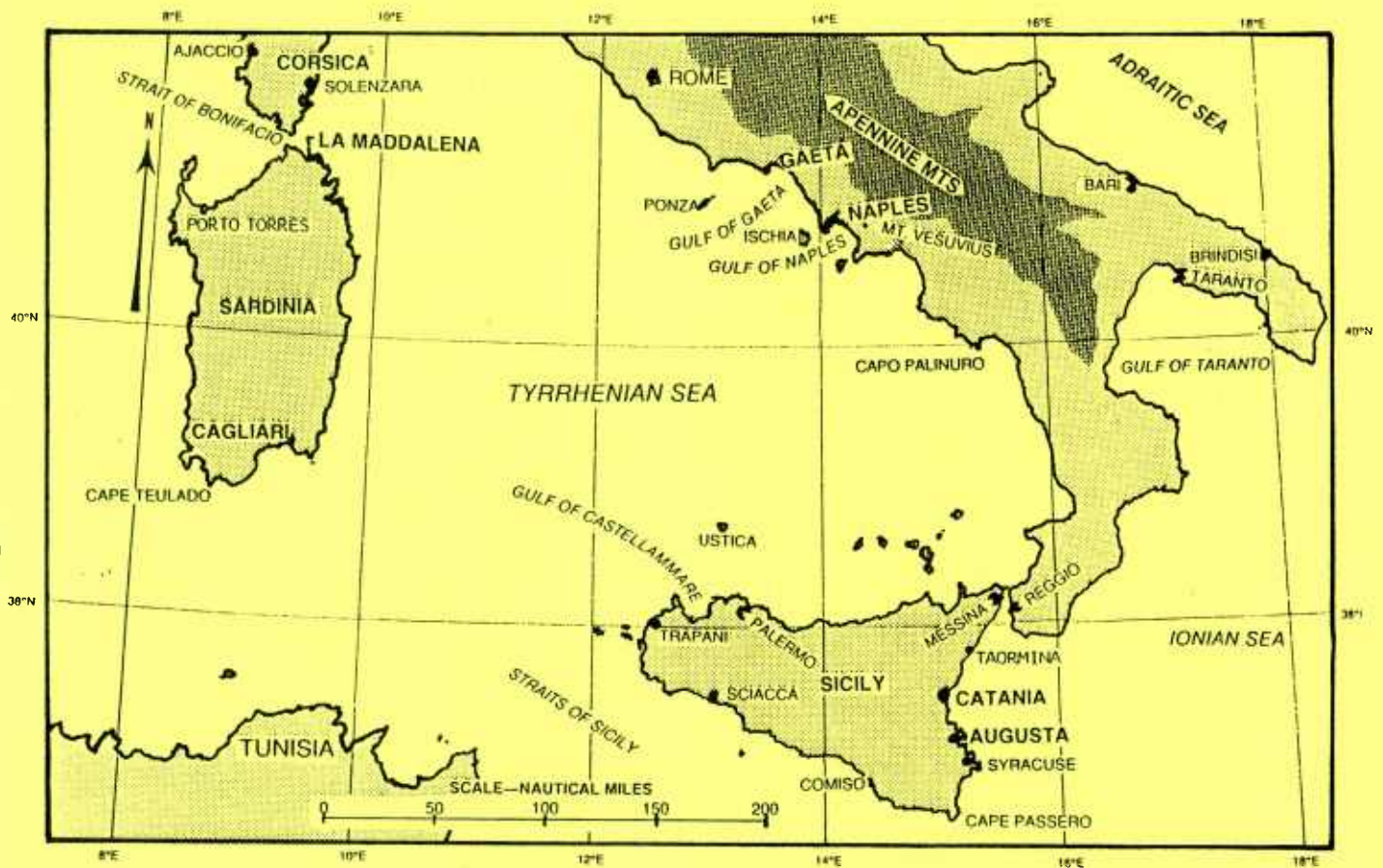


Figure 2-1. Ports of Italy, Sicily, and Sardinia

The Port is situated about 30 n mi southwest of the northeastern tip of Sicily and the Strait of Messina (Figure 2-2). The coastline near Taormina is rugged, with elevations near the shore commonly exceeding 600 ft (183 m), and those only 1 1/2 mi inland often approaching 2,000 ft (610 m). Mt. Etna, a 10,902 ft (3,323 m) active volcano, is located approximately 15 mi west-southwest of the Port.

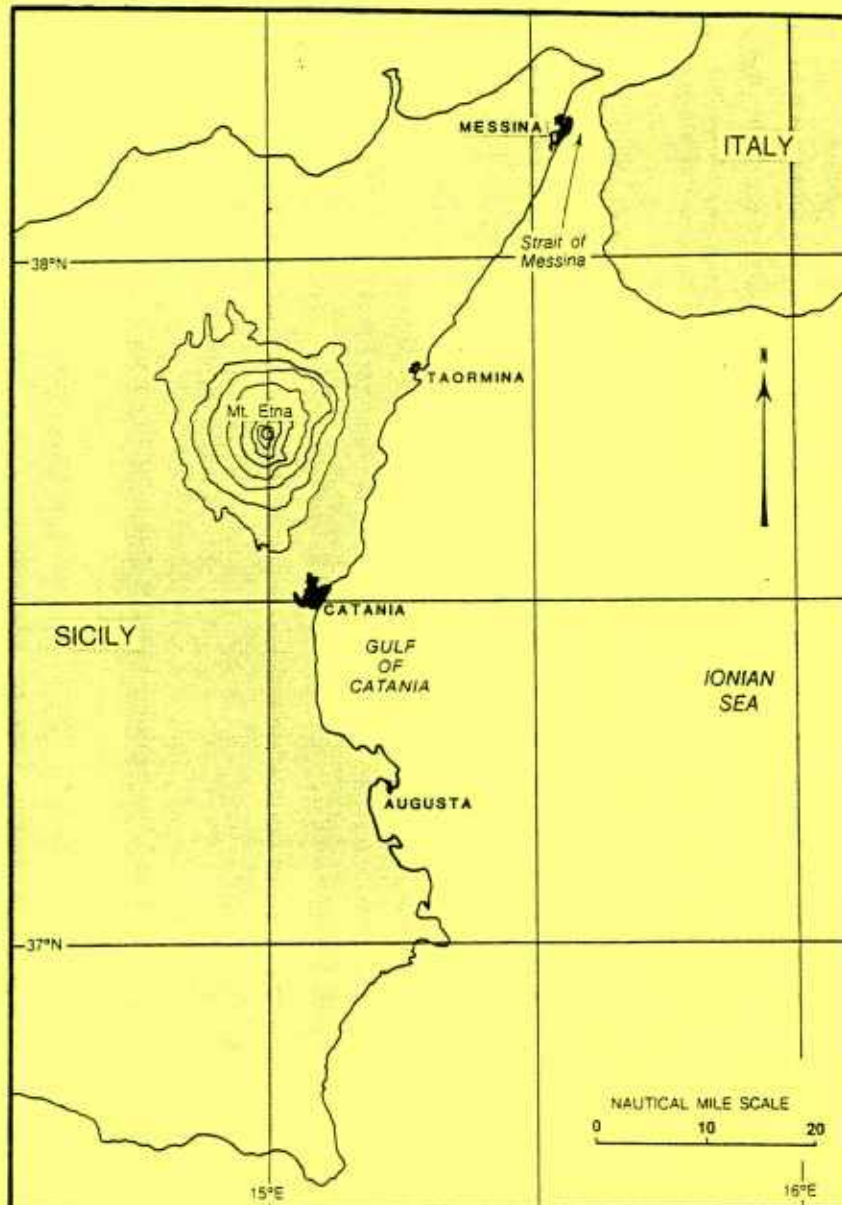


Figure 2-2. East Coast of Sicily

The Port of Taormina is located on Rada di Taormina and is entered between two small promontories, Capo di Taormina to the north and Capo Schiso to the south. Capo Schiso is low and black, and is the eastward extremity of a long, old lava stream erupted by Mt. Etna (Hydrographic Department, 1963). See Figure 2-3. The city of Taormina lies just northwest of Capo di Taormina, while a second community, Giardini, lies west and northwest of Capo Schiso. A high concrete breakwater extends some 991 ft (302 m) north-northeastward from Capo Schiso (FICEURLANT, 1987). The Fleet Landing for U.S. Navy ships is situated just west of the jetty/breakwater on the north tip of Capo Schiso.

Port facilities are limited; berthing is nonexistent for vessels larger than a minesweeper. Consequently, U.S. Navy ships anchor out. Two anchorages, indicated as A and B on Figure 2-3, are designated in depths of 66 ft (20 m) and 49 ft (15 m) respectively, but are not suitable for a deep draft vessel. It is recommended that larger vessels anchor approximately 1,500 ft (457 m) farther east. Holding in the anchorages is rated as good. However, the anchorages are on a rather steeply sloping bottom, so anchor dragging can be a problem in some wind situations (FICEURLANT, 1987). Both anchorages are exposed to winds and seas from the east quadrant; there is no place to evade such conditions in the Port.

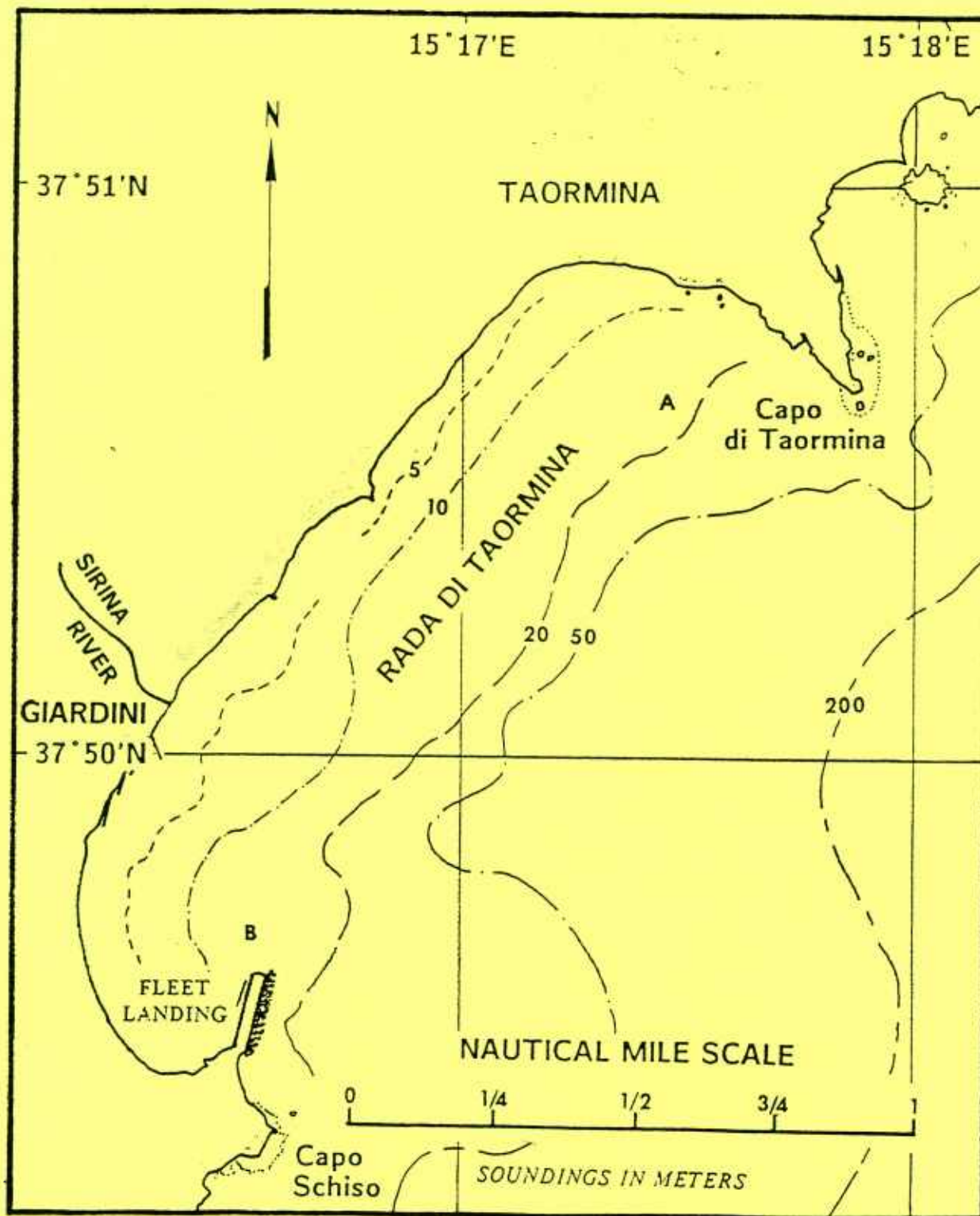


Figure 2-3. Port of Taormina.

The Port Directory for Taormina, published in 1987 by Fleet Intelligence Center Europe and Atlantic, Norfolk, VA, states that currents are primarily influenced by the wind and generally flow north to south. An interview with local authorities, however, indicates the current at Taormina changes direction every 12 hours, reaching a peak speed of 2 kt that lasts about an hour before slowing. The same local authorities state that the Sirina River (see Figure 2-3), which divides the cities of Taormina and Giardini, may cause variable currents near its mouth; this depends on the amount of runoff. Tides at Taormina are negligible, with a range of less than 1 ft (30 cm).

Specific hazardous conditions, vessel situations, and suggested precautionary/evasive action scenarios are summarized in Table 2-1.

Table 2-1. Summary of hazardous environmental conditions for the Port of Taormina, Sicily, Italy.

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
<p>1. <u>Strong wind from NE to E</u> - Locally known as "Gregante".</p> <ul style="list-style-type: none"> * Most likely to occur during November - March period. * Typical event has 40 kt winds with 50 kt maximum. * Typical event is accompanied by 6-10 ft (2-3 m) waves, but long-period swell waves of 10 to 14 ft (3-4 m) usually follows wind onset. * Exceptionally strong event may occur about once every 25 years. Waves may breach seawall and inundate coastal area. * Likely to be accompanied by cloudy, rainy weather. 	<p><u>Advance warning.</u></p> <ul style="list-style-type: none"> * Existing or building high pressure over Europe with development of low pressure over Ionian Sea or N Africa. * Transient low passing S of Sicily. <p><u>Duration.</u></p> <ul style="list-style-type: none"> * If caused by quasi-stationary low over N Africa, Gregante winds may last 5 days. * If caused by transient low, wind may last 1-2 days. * Long-period waves may persist for 2-3 days after wind abates. * Heights diminish very little the first day, then gradually thereafter. 	<p>(1) <u>Anchored - N anchorage.</u></p> <p>(2) <u>Anchored - S anchorage.</u></p> <p>(3) <u>Arriving/departing.</u></p> <p>(4) <u>Small Boat operations.</u></p> <p><u>All locations/situations.</u></p>	<p>(a) <u>THE PORT OFFERS NO PROTECTION FROM HEAVY WEATHER.</u></p> <ul style="list-style-type: none"> * Vessels may have to depart anchorage for waters that are more protected. * The nearby Port of Messina offers good protection. * If wind has a strong N component, Capo di Taormina may afford limited protection from worst conditions, but leaving harbor is recommended. * If wind is NE or E, weighing anchor and leaving is recommended. * Even though holding is good on a sandy bottom, the winds may cause anchor dragging due to bottom slope. * If wind is E, consider moving north through Strait of Messina to lee of high terrain on N coast of Sicily or W coast of Italian Peninsula. <p>(a) <u>THE PORT OFFERS NO PROTECTION FROM HEAVY WEATHER.</u></p> <ul style="list-style-type: none"> * <u>Worst condition for this anchorage.</u> * Vessels should weigh anchor and seek more protected anchorages. * The nearby Port of Messina offers good protection. * If wind has a strong E component, consider moving north through Strait of Messina to anchorages in lee of high terrain on N coast of Sicily or W coast of Italian Peninsula. <p>(a) <u>THE PORT OFFERS NO PROTECTION FROM HEAVY WEATHER.</u></p> <ul style="list-style-type: none"> * Inbound vessels should not enter Port, but should opt for a more protected anchorage. <p>(b) <u>Outbound vessels should depart without delay if a Gregante event is forecast.</u></p> <p>(a) <u>Small boat operations should be secured.</u></p> <p>(a) <u>Fine, gritty particles of ash can damage delicate equipment and equipment with close tolerances.</u></p> <ul style="list-style-type: none"> * Secure unnecessary equipment. * Protect all equipment from contact with ash particles. * Change/clean air filters <u>often</u> on gasoline/diesel engines which must remain operating. <p>(b) <u>Ash may pose health hazard.</u></p> <ul style="list-style-type: none"> * Minimize personnel exposure on weather decks to avoid ash inhalation and exposure to accidents on slippery surfaces. <p>(c) <u>Visibility may be severely reduced during a powerful eruption.</u></p> <p>(a) <u>Wind may raise rough water in vicinity of Fleet Landing.</u></p> <ul style="list-style-type: none"> * Boats may need to secure runs to/from Fleet Landing until wind abates.
<p>2. <u>Ash fall from Mt. Etna</u> - Caused by eruption or emission of an ash plume from Mt. Etna.</p>	<p><u>Advance warning</u></p> <ul style="list-style-type: none"> * May occur anytime Mt. Etna erupts or emits an ash plume and prevailing winds are from the WSW. 		
<p>3. <u>Strong NW wind</u> - Caused by Mistral winds which originate in the Gulf of Lion, extending across the W Mediterranean Sea and reaching E Sicily.</p>	<p><u>Advance warning</u></p> <ul style="list-style-type: none"> * Possible anytime a strong Mistral outbreak is observed to be spreading SE across the W Mediterranean Sea. 	<p>(1) <u>Small boat operations.</u></p>	

Table 2-1. (Continued)

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
<p>4. <u>Strong wind from SE</u> - Known as Scirocco.</p> <ul style="list-style-type: none"> * Most common March through June. * Typical event has 40 kt winds with 50 kt maximum. * Typical event is accompanied by 6-10 ft (2-3 m) waves, but long-period swell waves of 10-14 ft (3-4 m) usually follows onset of wind. * Brings hot, muggy weather to Taormina in spring and summer, warm weather in winter. 	<p><u>Advance warning</u></p> <ul style="list-style-type: none"> * Usually preceded by low clouds on the SE horizon 12-24 hr prior to onset. * Cumuliform clouds forming and staying over Mt. Etna during SE flow. <p><u>Duration</u></p> <ul style="list-style-type: none"> * May last 2 weeks or longer. <p><u>Changes in wind</u></p> <ul style="list-style-type: none"> * Dense belts of altocumulus castellanus approaching from the southwest are at times associated with radical and sudden changes in both the direction and speed of the wind 	<p>(1) <u>Anchored - N anchorage.</u></p> <p>(2) <u>Anchored - S anchorage.</u></p> <p>(3) <u>Arriving/departing.</u></p> <p>(4) <u>Small Boat operations.</u></p>	<p>(a) <u>THE PORT OFFERS NO PROTECTION FROM HEAVY WEATHER.</u></p> <ul style="list-style-type: none"> * Worst condition for this anchorage. * Vessels should weigh anchor and seek more protected anchorages. * The nearby Port of Messina offers good protection. * Passing through Strait of Messina to lee of the high terrain on N coast of Sicily or W coast of the Italy should be considered. * SE'ly winds tend to swirl around the high, rocky coast and have the effect of coming from landward. Ship's accommodation ladders should be rigged to the port quarterdeck to ensure the best lee available. * Scirocco conditions may result in extremely anomalous radar and radio propagation due to the strong surface inversion produced over the water, especially in spring. Helicopters are liable to be out of radio contact at a range of 1-2 n mi. <p>(a) <u>THE PORT OFFERS NO PROTECTION FROM HEAVY WEATHER.</u></p> <ul style="list-style-type: none"> * Vessels may have to depart anchorage for more protected waters. * The nearby Port of Messina offers good protection for vessels mooring in the inner harbor. Vessel size limitations may preclude entry. * Capo Schiso affords limited protection from worst conditions, but weighing anchor is recommended. * Moving N through Strait of Messina to anchorages in the lee of high terrain along the N coast of Sicily or the W coast of the Italian Peninsula should be considered. * Even though holding is good on a sandy bottom, wind may cause anchor dragging due to bottom slope. * SE'ly winds tend to swirl around the high, rocky coast and have the effect of coming from landward. Ship's accommodation ladders should be rigged to the port quarterdeck to ensure the best lee available. * Scirocco conditions may result in extremely anomalous radar and radio propagation due to the strong surface inversion produced over the water, especially in spring. Helicopters are liable to be out of radio contact at a range of 1-2 n mi. <p>(a) <u>THE PORT OFFERS NO PROTECTION FROM HEAVY WEATHER.</u></p> <ul style="list-style-type: none"> * Inbound vessels should not enter port, but opt for a more protected anchorage. * SE'ly winds tend to swirl around the high, rocky coast and have the effect of coming from landward. Ship's accommodation ladders should be rigged to the port quarterdeck to ensure the best lee available. * Scirocco conditions may result in extremely anomalous radar and radio propagation due to the strong surface inversion produced over the water, especially in spring. Helicopters are liable to be out of radio contact at a range of 1-2 n mi. <p>(b) <u>Outbound vessels should depart without delay if a Scirocco event is forecast.</u></p> <ul style="list-style-type: none"> * Scirocco conditions may result in extremely anomalous radar and radio propagation due to the strong surface inversion produced over the water, especially in spring. Helicopters are liable to be out of radio contact at a range of 1-2 n mi. <p>(a) <u>Small boat operations should be secured.</u></p>

SEASONAL SUMMARY OF HAZARDOUS WEATHER CONDITIONS

WINTER (November through February):

- * Northeast and east winds (Gregante) and waves. Lasts up to 5 days. Wind 40-50 kt; waves 6-10 ft (2-3 m); swell 10-14 ft (3-4 m). Swell lasts 2-3 days after wind abates.
- * Southeast winds (Scirocco) and waves. Wind 40-50 kt; waves 6-10 ft (2-3 m); swell 10-14 ft (3-4 m). Brings warm weather in winter.

SPRING (March through May):

- * Early spring similar to winter. Most Scirocco events occur from March through June.
- * Occasional short periods of early morning fog; visibility near zero.

SUMMER (June through September):

- * During afternoons anchorage areas occasionally experience a sudden onset of northeast 25 kt winds and, on other occasions, southeast swell.
- * Thunderstorms may occur in August, but are usually short in duration (20 minutes or so) and not severe.
- * Scirocco events are uncommon after June.

AUTUMN (October):

- * Short transition season with winter-like weather returning by month's end.

NOTE: For more detailed information on hazardous weather conditions, see previous Table 2-1 in this section and Hazardous Weather Summary in Section 3.

REFERENCES

FICEURLANT, 1987: Port Directory for Taormina/Giardini, Sicily, Italy. Fleet Intelligence Center Europe and Atlantic, Norfolk, VA.

Hydrographic Department, 1963: Mediterranean Pilot. Volume I. Hydrographer of the Navy, London, England.

PORT VISIT INFORMATION

MAY 1988. NEPRF Meteorologists R. Fett and D. Perryman met with Mr. Pietro Ranieri, part-time pilot and local fisherman, to obtain much of the information included in this port evaluation.

3. GENERAL INFORMATION

This section is intended for Fleet meteorologists/oceanographers and staff planners. Section 3.5 includes a general discussion of hazards and Table 3-1 provides a summary of vessel locations/situations, potential hazards, effect-precautionary/evasive actions, and advance indicators and other information by season.

3.1 Geographic Location

The Port of Taormina is located on the east coast of the Italian island of Sicily at approximately 37°50'N 15°16'E (Figure 3-1).

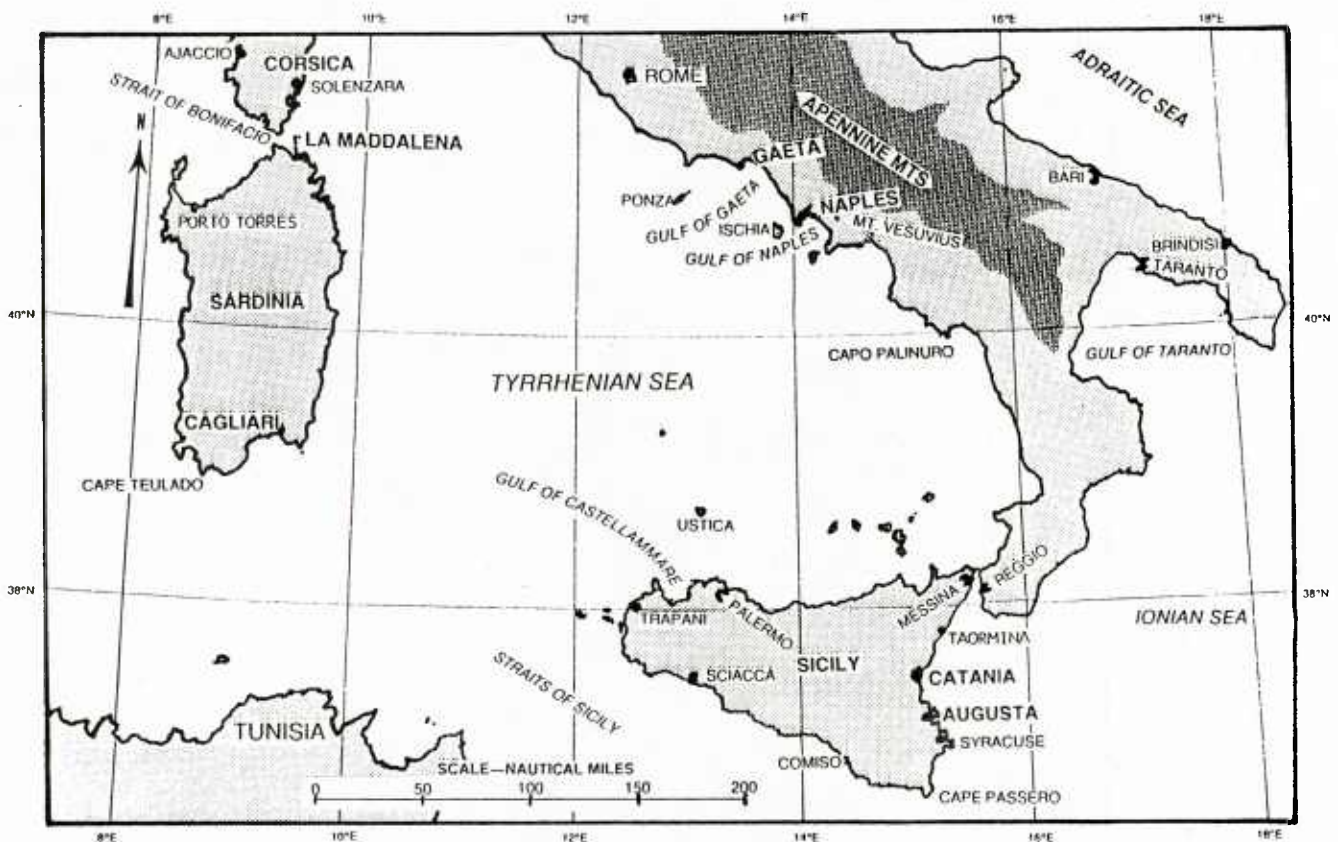


Figure 3-1. Ports of Italy, Sicily, and Sardinia.

The Port is situated about 30 n mi southwest of the northeastern tip of Sicily and the Strait of Messina (Figure 3-2). The coastline near Taormina is rugged, with elevations near the shore commonly exceeding 600 ft (183 m), and those only 1 1/2 mi inland often approaching 2,000 ft (610 m). Mt. Etna, a 10,902 ft (3,323 m) active volcano, is located approximately 15 mi west-southwest of the Port.

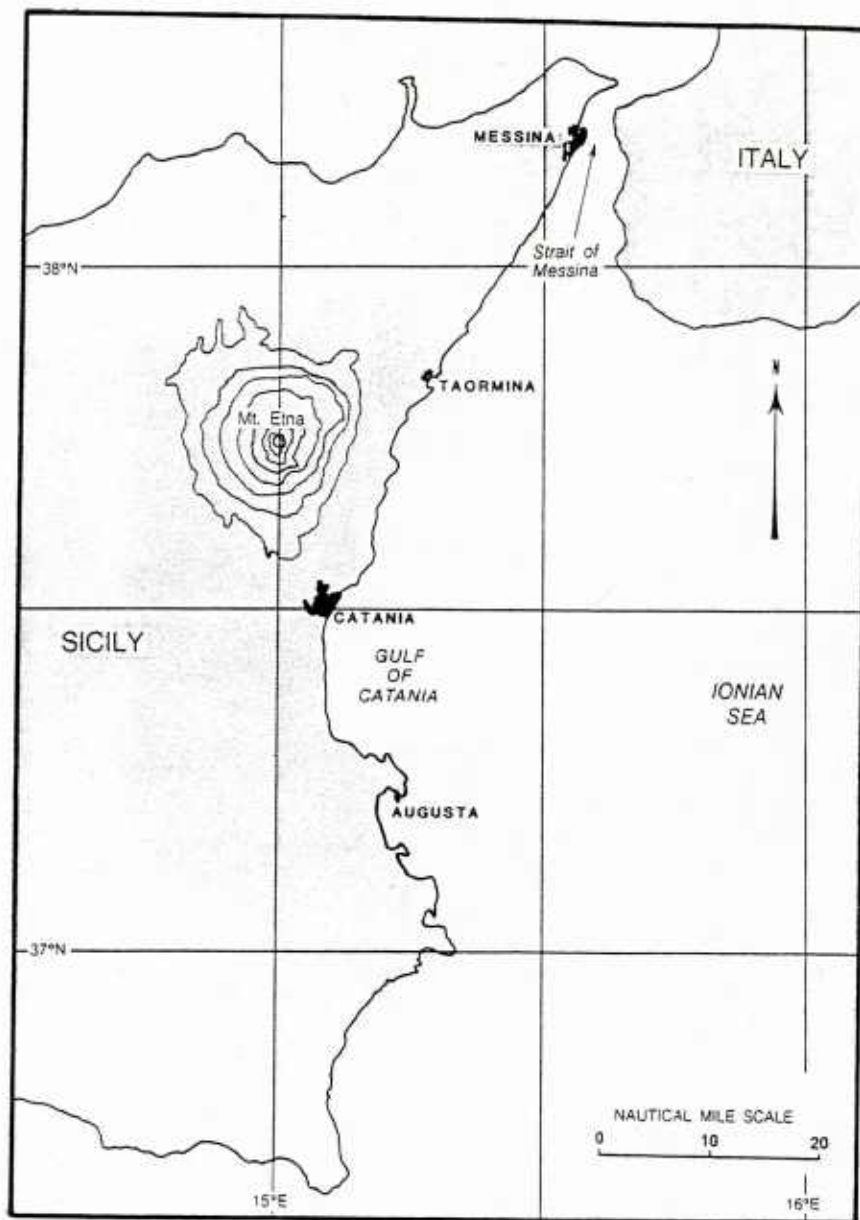


Figure 3-2. East Coast of Sicily.

The Port of Taormina is located on Rada di Taormina and is entered between two small promontories, Capo di Taormina to the north, and Capo Schiso to the south. Capo Schiso is low and black, and is the eastward extremity of a long, old stream of lava erupted by Mt. Etna (Hydrographic Department, 1963). See Figure 3-3. The city of Taormina lies just northwest of Capo di Taormina, while a second community, Giardini, lies west and northwest of and Capo Schiso. A high, concrete breakwater extends some 991 ft (302 m) north-northeastward from Capo Schiso (FICEURLANT, 1987). The Fleet Landing for U.S. Navy ships is situated just west of the jetty/breakwater on the north tip of Capo Schiso.

Port facilities are limited; berthing is non-existent for vessels larger than a mine sweeper. Consequently, U.S. Navy ships anchor out. Two anchorages, indicated as A and B on Figure 3-3, are designated in depths of 66 ft (20 m) and 49 ft (15 m) respectively, but are not suitable for a deep draft vessel. It is recommended that larger vessels anchor approximately 1,500 ft (457 m) farther east. Holding in the anchorages is rated as good (FICEURLANT, 1987).

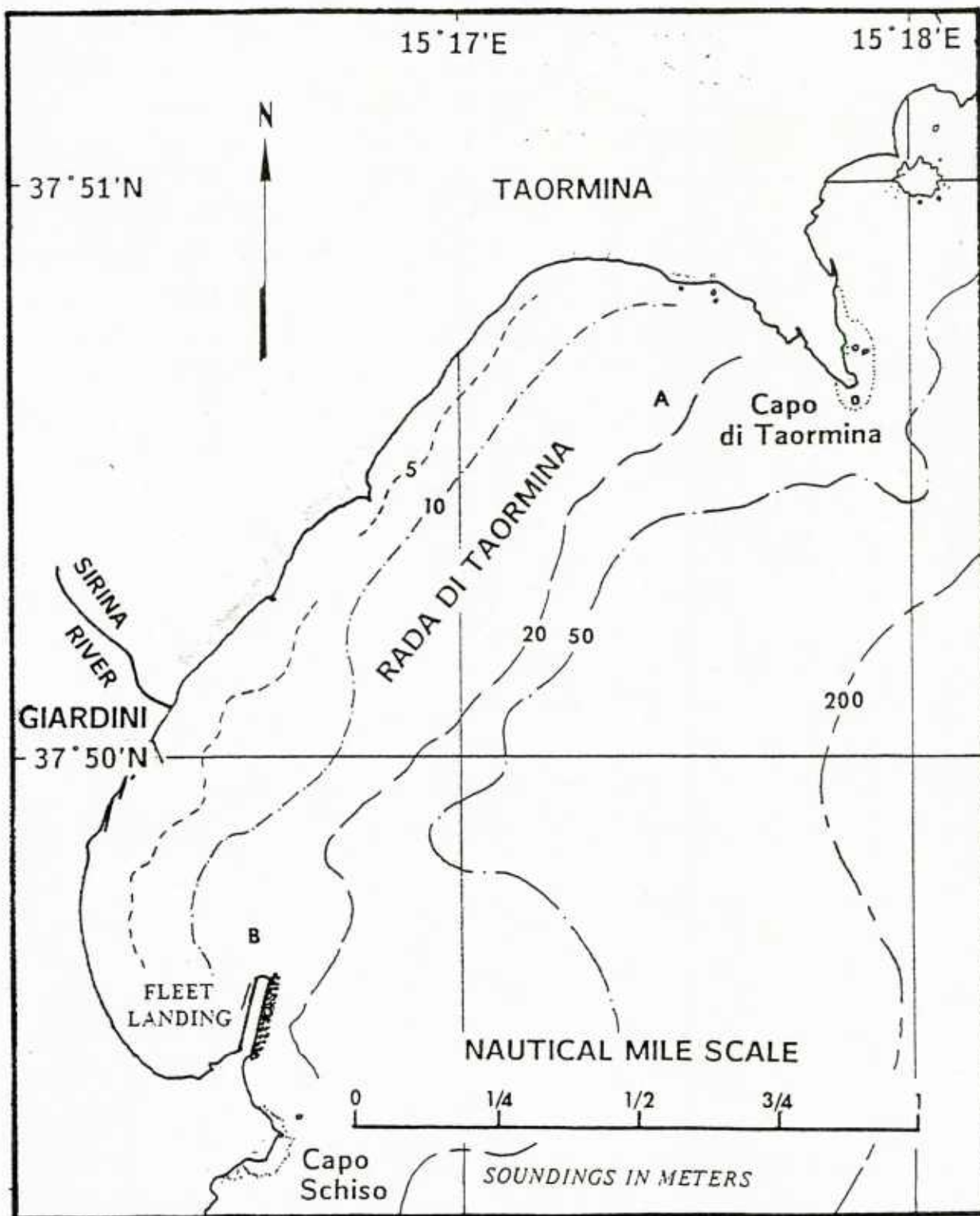


Figure 3-3. Port of Taormina.

With the exception of the waters west of the breakwater near Capo Schiso, the Port of Taormina offers no protection from winds with a strong easterly component. For example, a recent visit by a U.S. Navy ship was cut short due to strong northeasterly winds which forced the cancellation of boating operations.

The anchorages are fully exposed to winds and seas from the northeast, east, and southeast. Although holding is rated good on a sandy bottom, water depths increase steeply to seaward. When this fact is coupled to quickly changing wind conditions, anchor dragging can result.

The Port offers no shelter from strong winds or heavy seas from the eastern semicircle, and is best avoided if such conditions exist or are forecast.

Currents and Tides

The Port Directory for Taormina, published in 1987 by Fleet Intelligence Center Europe and Atlantic, Norfolk, VA, states that currents are primarily influenced by the wind and generally flow north to south. An interview with local authorities, however, indicates the current at Taormina changes direction every 12 hours, reaching a peak speed of 2 kt that lasts about an hour before slowing.

Local authorities state that the Sirina River (see Figure 3-3) which divides the cities of Taormina and Giardini, may cause variable currents near its mouth; this depends on the amount of runoff.

Tides at Taormina are negligible, with a range of less than 1 ft (30 cm).

3.4 Visibility

Visibility is generally very good, but during March and April, early morning visibility is occasionally reduced to near zero due to fog. The restriction usually lasts less than an hour before improving. Ash storms caused by Mt. Etna may occur during any month, and visibility may be severely affected in a powerful eruption.

3.5 Hazardous Conditions

The Port of Taormina, including its anchorages, is exposed to heavy weather from the east semicircle. Winds with a westerly component, such as the northwesterly Mistrals which infrequently reach the island, have little or no effect on Port operations.

Although rare, storms having tropical cyclone characteristics with fully developed eyes have been observed on at least three occasions in the Mediterranean Basin. During the last occurrence, in September 1983, the storm moved from the Gulf of Gabes, through the Straits of Sicily, along the east coast of Sardinia and into the Gulf of Genoa. Winds of 60 kt were reported at Cagliari, Sardinia while winds near the storm's eye were 100 kt.

More commonly, cyclonic storms developing in the Gulf of Genoa and moving southeastward through the Tyrrhenian Sea and over Sicily or over southern Italy will cause most of Sicily's high winds. Depending on the location of the low, winds with a north or south component will have higher speeds in the area of the Strait of Messina due to funneling. These funneled winds can be as much as three times the speed of the synoptic wind.

A seasonal summary of various known environmental hazards that may be encountered in the Port of Taormina follows.

A. Winter (November through February)

The worst conditions for vessels in the southern anchorage and at the Fleet Landing adjacent to Capo Schiso occur during northeast to east winds. The northern anchorage is also adversely affected but to a lesser degree. Locally called "Gregante," a normal outbreak will produce winds of 40 to 50 kt and be accompanied by waves of 6 to 10 ft (2 to 3 m). Long-period swell of 10 to 14 ft (3 to 4 m) usually follows the onset of wind. Gregante winds are the likely result when high pressure lies or is building over central Europe or the Balkans and a low pressure system is over the Ionian Sea, North Africa near Libya/Tunisia, or transiting eastward south of Sicily. A transiting low may produce winds lasting a day or two, but a quasi-stationary low over the Ionian Sea or Libya/Tunisia may produce winds lasting up to 5 days. The long-period swell may persist for 2-3 days after the wind abates, diminishing very little the first day, and gradually thereafter. Winds with a strong northeast component may be reinforced when passing through the Strait of Messina and can reach Taormina as supergradient winds. The Fleet Landing is exposed to the north and northeast and is a hazardous area during these outbreaks. In addition to the winds, lows passing south of Sicily may cause low clouds and heavy rain at Taormina. Every 25 years or so, a bad storm will hit the area, generating waves which breach the seawall and inundate buildings along beach front streets.

Southeasterly Scirocco winds are the worst for vessels in the northern anchorage. A typical Scirocco event may bring winds of 40 to 50 kt to Taormina and be

accompanied by waves of 6 to 10 ft (2 to 3 m). Long-period swell of 10 to 14 ft (3 to 4 m) usually follows wind onset. Sciroccos are normally caused by one of the following: a well developed low pressure system over North Africa, or winds within the warm sector of a low pressure system north of the Mediterranean Sea. They will bring hot, muggy weather to the region in spring and summer, and warm weather in winter. The Scirocco can occur during any season, but is most frequent from March through June (Brody and Nestor, 1980). A Scirocco event usually lasts for 2 weeks or less, but one event on record lasted one month. In either case, most of the associated winds would be less than the 40 to 50 kt maximum mentioned above. The long-period swell may persist for 2 to 3 days after the wind abates, diminishing very little the first day, then gradually thereafter. Southeast winds tend to swirl around the high, rocky coast and have the effect of coming from landward (FICEURLANT, 1987).

Northwesterly Mistral winds occasionally reach eastern Sicily from the Gulf of Lion and can raise rough water near the Fleet Landing. Weather is generally good during Mistral winds. In general, wintertime visibility is good.

B. Spring (March through May)

Early spring weather at Taormina is much the same as that of winter. Winds and seas generated by Gregante conditions continue to occur, but with decreasing frequency after March. According to local authorities, most all the bad weather at Taormina occurs between November and March. But, as mentioned above, Scirocco winds are most frequent from March through June.

Early morning visibility is infrequently reduced to near zero during March and April. Severe restrictions usually last less than an hour.

C. Summer (June through September)

By summer, the extratropical storm track has moved north of the Mediterranean Basin, so the major causes of strong winds no longer pose a threat to the Taormina area. Scirocco winds are common through June, but are rare the rest of the summer as the mean wind flow along the North African coast is landward from the relatively cool sea (Brody and Nestor, 1980). The anchorage areas are normally calm, but sudden northeasterly winds to 25 kt and occasional swells from the southeast should be expected in the afternoon (FICEURLANT, 1987). Afternoon sea breezes are not significant at Taormina. Thunderstorms may occur in August, but only last 20 minutes or so and are not severe.

D. Autumn (October)

The autumn season over eastern Sicily is short, usually lasting the month of October. The extratropical storm track moves southward from its summertime location over Europe. By the end of the month, extratropical storms again transit the northern Mediterranean /southern Europe region. The threat of strong Gregante winds discussed in section A above increases as the month progresses.

3.6 Harbor Protection

Except as detailed below, the Port of Taormina offers no protection from winds or waves.

3.6.1 Wind and Weather

The Port of Taormina is exposed to the full force of wind from north-northeast clockwise through south. Vessels anchored in the north part of Rada di Taormina and in the lee of Capo di Taormina may be afforded limited protection by the promontory, but the effect would be minimal. Similarly, vessels anchored in the south part of Rada di Taormina adjacent to Capo Schiso would be afforded some protection from southerly winds, but the effect would also be minimal. The landmass of Sicily affords protection from all but the strongest winds from south-southwest clockwise through north.

3.6.2 Waves

The Port is exposed and vulnerable to open ocean wave action from east through south, where fetch length is essentially unrestricted. Fetch length is near zero from south-southwest through north, so waves from those directions are not a threat. Fetch length increases to 20 to 30 n mi to the northeast, however, so winds from that direction could generate seas sufficient to affect small boat operations.

Ships anchored in the northern anchorage in the lee of Capo di Taormina may avoid northeasterly waves, while those anchored in the southern anchorage near Capo Schiso may gain protection from southerly waves. The Fleet Landing is well protected from south and

southeasterly conditions, but a northwest wind will generate rough water near the boat landing.

3.7 Protective and Mitigating Measures

3.7.1 Moving to a New Anchorage

When strong winds from northeast to southeast are forecast, vessels should weigh anchor and seek better protected waters. Depending on ship size, mooring in the inner harbor at Messina should be considered as Messina generally affords good protection from heavy weather. With east to southeast winds, if Messina is not a viable alternative, an option is to pass through the Strait of Messina, turn west, and anchor in safe waters in the lee of the high terrain. If north to northeast winds are forecast and departing Taormina is not feasible, vessels in the south anchorage should consider moving to the north anchorage where the promontory of Capo di Taormina could provide protection from larger waves. Wind could hamper small boat operations, however. Similarly, if south winds are forecast, vessels in the north anchorage should consider a move to the south anchorage where limited protection would be afforded by Capo Schiso. According to local authorities, in either of the aforementioned circumstances, there are no places to hide from heavy weather in the Taormina/Giardini area.

3.7.2 Scheduling

The lack of a regular land/sea breeze regime during the warmer months makes the scheduling of specific evolutions (i.e. anchoring, weighing anchor, small boat operations, etc.) easier. However, because of

the possibility of a sudden onset of brisk winds during summer afternoons (see 3.5 C above), it would be advisable to complete small boat operations before noon if possible.

3.7.3 Rigging for Small Boat Operations

Southeast winds tend to swirl around the high, rocky coast and have the effect of coming from landward. The ship's accommodation ladder should be rigged to the port quarterdeck to ensure the best lee available (FICEURLANT, 1987).

3.8 Local Indicators of Hazardous Weather Conditions

Northeast to East Gregante Winds and Associated Waves - Strong winds from the east quadrant are caused by a steep north-south pressure gradient. Meteorologists should be alert for high pressure over central Europe or the Balkans, and low pressure over the Ionian Sea, North Africa near Libya/Tunisia, or transiting eastward south of Sicily. Wind duration may last a day or so with a transiting low or up to 5 days with a low over North Africa. Long-period swell waves may reach Taormina for 2 to 3 days after the wind abates, diminishing little the first day, then gradually thereafter.

Southeasterly Scirocco Winds - A Scirocco event is usually preceded by low clouds to the southeast about 12 to 24 hours prior to onset.

Cumuliform clouds, which form and stay over Mt. Etna during southeasterly flow over eastern Sicily, are an indicator of a forthcoming Scirocco.

Increasing southerly winds at coastal stations along the northeast coast of Libya indicate the start of a Scirocco (Brody and Nestor, 1980).

Forecast a strong Scirocco if two conditions are met: (1) an upper trough is present over the Balkans with a strong jet stream along its southern boundary; and (2) large pressure falls (after the diurnal pressure is removed) are observed at stations along the east coast of Tunisia (Brody and Nestor, 1980).

Scirocco conditions crossing the Island of Sicily produce strong and gusty foehn-type winds on the north and east sides of the island. It has been noted that during these situations, ships experience better weather conditions south of Sicily than north of the island. Sea conditions, however, would be better north of Sicily due to the short fetch (Brody and Nestor, 1980).

During a Scirocco, dense belts of altocumulus castellanus approaching from the southwest (probably associated with weak upper-level troughs) are, at times, associated with radical and sudden changes in both the direction and speed of the wind (Brody and Nestor, 1980).

The surface inversion that occurs over the relatively cool water during a spring Scirocco causes extremely anomalous radar and radio propagation in the dust-laden atmosphere below the inversion; helicopters are liable to be out of radio contact at a range of 1-2 n mi (Brody and Nestor, 1980).

Weather associated with a Scirocco is largely dependent on both the length of the wind's overwater trajectory and the wind speed. High wind speeds and short overwater trajectories produce large amounts of dust that reduces visibility, while low wind speeds and

long overwater trajectories produce high humidities with fog and poor visibilities (Brody and Nestor, 1980).

Rain - A "hat" cloud atop Mt. Etna usually means rain the next day. Precipitation amounts are indicated by the cloud size; a larger cloud means more rain.

Northwesterly Mistral Winds - Wave clouds visible on satellite imagery extending from Sardinia to Sicily are indicative of a gale force Mistral that extends SE into the Strait of Sicily. Consequently, these wave clouds could also indicate possible forthcoming northwesterly Mistral winds at Taormina.

3.9

Summary of Problems, Actions, and Indicators

Table 3-1 is intended to provide easy-to-use seasonal references for meteorologists on ships using the Port of Taormina. Table 2-1 (Section 2) summarizes Table 3-1 and is intended primarily for use by ship captains.

Table 3-1. Potential problem situations at the Port of Taormina, Sicily, Italy - ALL SEASONS

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
<p>1. <u>Anchored - N Anchorage.</u> OR <u>Anchored - S Anchorage.</u></p> <p>Strongest in Winter and early Spring Uncommon in Summer May occur in Autumn</p> <p>Most common in Spring and early Summer May occur in Autumn and Winter</p> <p>Independent of season</p>	<p>a. <u>NE-E'ly winds/waves</u> - Locally called "Gregante." Worst for vessels in the S anchorage, but can bring adverse effects to the N Anchorage also. Occurs mainly during November to March. Wind speeds may reach 40-50 kt and be accompanied by 6-10 ft (2-3 m) waves. Long-period swell of 10-14 ft (3-4 m) usually follows wind onset. May last 1 to 5 days depending on cause. Long-period swell may persist for 2-3 days after winds abate, with heights diminishing little the first day, then gradually thereafter. Approximately every 25 years or so, an exceptionally strong storm occurs, generating waves which breach the seawall and inundate the beach front between Capo Schiso and Capo di Taormina.</p> <p>b. <u>SE'ly winds/waves</u> - Called Scirocco. Worst for vessels in the N Anchorage but can bring adverse effect to the S anchorage also. Winds of 40-50 kt are possible, accompanied by waves of 6-10 ft (2-3 m). Long-period swell of 10-14 ft (3-4 m) usually follows wind onset. Long-period swell may persist for 2-3 days after wind abates, with heights decreasing little the first day, then gradually diminishing. Scirocco events bring hot, muggy weather to the region in spring and summer, warm weather in winter. Usually lasts for 2 weeks or less, but may last up to 1 month.</p> <p>c. <u>Ash fall from Mt. Etna</u> - Common occurrence anytime Mt. Etna erupts or emits an ash plume and the prevailing wind is from WSW.</p>	<p>a. Worst conditions for the south anchorage. A strong event from E will make the anchorages unusable, as they are exposed to the full force of E'ly conditions. Vessels should weigh anchor and seek better protected waters. The Port of Messina offers good protection and should be considered. If vessel size or other factors preclude the use of Messina, The N coast of Sicily or W coast of Italy should then be considered. If the winds/waves have a strong N component, Capo di Taormina may provide enough shelter to allow vessels to remain in the north anchorage. But, although holding on the sandy bottom is good, the sloping bottom makes anchor dragging a problem in windy situations.</p> <p>b. Worst conditions for the north anchorage. SE'ly winds tend to swirl around the high, rocky coast and have the effect of coming from landward. Although holding on the sandy bottom is good, the bottom slope makes anchor dragging a problem; especially when the wind is from landward. Ship's accommodation ladders should be rigged to the port quarterdeck to ensure the best lee available. If a strong event is forecast, vessels should weigh anchor and move to the Port of Messina or other protected waters. The N coast of Sicily should also be considered. The S anchorage may provide a more protected environment than the N anchorage due to the lee of Capo Schiso. The surface inversion that occurs over the relatively cool water during a spring Scirocco causes extremely anomalous radar and radio propagation in the dust-laden atmosphere below the inversion; helicopters are liable to be out of radio contact at a range of 1-2 n mi. Scirocco winds crossing Sicily produce strong and gusty foehn-type winds on the N and E sides of the island. It has been noted that ships experience better weather conditions S of Sicily rather than N during these situations. Sea conditions, however, would be better N of Sicily due to the short fetch.</p> <p>c. The ash is slippery and will clog machinery. Visibility may be severely affected in a powerful eruption as the ash fall brings semi-darkness to daylight hours. Wherever possible, exposed machinery should be secured and protected from ash. Personnel should take precautions against accidental slipping on ash-covered weather decks, and avoid inhalation of the ash.</p>	<p>a. Gregante winds are the likely result of a steep pressure gradient caused when high pressure is lying or building over Central Europe or the Balkans, and a low pressure system is over the Ionian Sea, North Africa near Libya/Tunisia, or transiting eastward south of Sicily. Prognostic charts should be reviewed with this scenario in mind.</p> <p>b. Scirocco winds are usually associated with a well-developed low pressure system over N Africa or the warm sector of a low pressure system located N of the Mediterranean Sea which transports the warm, moist air to Sicily. Scirocco winds are usually preceded by low clouds on the SE horizon about 12-24 hr prior to onset. Another indicator (used at Catania) is cumuliform clouds which form and stay over Mt. Etna during SE flow over N Sicily. Increasing S'ly winds at coastal stations along the NE coast of Libya indicate the start of a Scirocco. The following conditions indicate a strong Scirocco should be forecast: (1) an upper trough is present over the Balkans with a strong jet stream along its southern boundary; and (2) large pressure falls (after the diurnal pressure is removed) are observed at stations along the east coast of Tunisia. Weather associated with a Scirocco is largely dependent on both the length of the wind's overwater trajectory and the wind speed. High wind speeds and short overwater trajectories produce large amounts of dust that reduce visibilities, while low wind speeds and long overwater trajectories produce high humidities with fog and poor visibilities.</p> <p>c. Ash falls are possible whenever Mt. Etna emits an ash plume and prevailing winds are from WSW.</p>

Table 3-1. (Continue)

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
2. <u>Arriving/departing.</u> Strongest in Winter and early Spring Uncommon in Summer May occur in Autumn	a. <u>NE-E'ly winds/waves</u> - Locally called "Gregante." Worst for vessels in the S anchorage, but can bring adverse effects to the N Anchorage also. Occurs mainly during November to March. Wind speeds may reach 40-50 kt and be accompanied by 6-10 ft (2-3 m) waves. Long-period swell of 10-14 ft (3-4 m) usually follows wind onset. May last 1 to 5 days depending on cause. Long-period swell may persist for 2-3 days after winds abate, with heights diminishing little the first day, then gradually thereafter. Approximately every 25 years or so, an exceptionally strong storm occurs, generating waves which breach the seawall and inundate the beach front between Capo Schiso and Capo di Taormina.	a. Inbound vessels should avoid entering the Port of Taormina if Gregante winds exist or are forecast. See 1.a and 2.a above, and 4.a below. Outbound vessels should weigh anchor and depart without delay if Gregante winds are forecast.	a. Gregante winds are the likely result of a steep pressure gradient caused when high pressure is lying or building over Central Europe or the Balkans, and a low pressure system is over the Ionian Sea, North Africa near Libya/Tunisia, or transiting eastward south of Sicily. Prognostic charts should be reviewed with this scenario in mind.
Most common in Spring and early Summer May occur in Autumn and Winter	b. <u>SE'ly winds/waves</u> - Called Scirocco. Worst for vessels in the N Anchorage but can bring adverse effects to the S anchorage also. Winds of 40-50 kt are possible, accompanied by waves of 6-10 ft (2-3 m). Long-period swell of 10-14 ft (3-4 m) usually follows wind onset. Scirocco events bring hot, muggy weather to the region in spring and summer, warm weather in winter. Usually lasts for 2 weeks or less but may last for 1 month.	b. Inbound vessels should avoid entering the Port of Taormina if Scirocco winds exist or are forecast. See 1.b and 2.b above, and 4.b below. Outbound vessels should weigh anchor and depart without delay if Scirocco winds are forecast.	b. Scirocco winds are usually associated with a well-developed low pressure system over N Africa or the warm sector of a low pressure system located N of the Mediterranean Sea which transports the warm, moist air to Sicily. Scirocco winds are usually preceded by low clouds on the SE horizon about 12-24 hr prior to onset. Another indicator (used at Catania) is cumuliiform clouds which form and stay over Mt. Etna during SE flow over N Sicily. Increasing S'ly winds at coastal stations along the NE coast of Libya indicate the start of a Scirocco. The following conditions indicate a strong Scirocco should be forecast: (1) an upper trough is present over the Balkans with a strong jet stream along its southern boundary; and (2) large pressure falls (after the diurnal pressure is removed) are observed at stations along the east coast of Tunisia. Weather associated with a Scirocco is largely dependent on both the length of the wind's overwater trajectory and the wind speed. High wind speeds and short overwater trajectories produce large amounts of dust that reduce visibilities, while low wind speeds and long overwater trajectories produce high humidities with fog and poor visibilities.
Independent of season	c. <u>Ash fall from Mt. Etna</u> - Common occurrence anytime Mt. Etna erupts or emits an ash plume and the prevailing wind is from WSW.	c. Inbound vessels should be aware of the problems associated with falling ash (i.e. clogged machinery and slippery decks) before committing to enter the Port.	c. Ash falls are possible whenever Mt. Etna emits an ash plume and prevailing winds are from WSW.

Table 3-1. (Continue)

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
<p>3. <u>Small boats.</u></p> <p>Strongest in Winter and early Spring Uncommon in Summer May occur in Autumn</p> <p>Most common in Spring and early Summer May occur in Autumn and Winter</p> <p>Independent of season</p> <p>Strongest in late Winter and early Spring May occur in Autumn</p>	<p>a. <u>NE-E'ly winds/waves</u> - "Gegante", lasts 1-5 days. Hazard most significant in S anchorage, can affect N anchorage too. Typically occurs November to March. Winds to 40-50 kt, waves 6-10 ft (2-3 m), long-period swell 10-14 ft (3-4 m) follows onset of winds. Long-period swell persists 2-3 days after wind abates, decreases very little the first day. Waves with 25 year storm will breach the seawall and inundate coastal areas.</p> <p>b. <u>SE'ly winds/waves</u> - Called Scirocco. Worst for vessels in the N Anchorage but can bring adverse effects to the S anchorage also. Winds of 40-50 kt are possible, accompanied by waves of 6-10 ft (2-3 m). Long-period swell of 10-14 ft (3-4 m) usually follows wind onset. Scirocco events bring hot, muggy weather to the region in spring and summer, warm weather in winter. Usually lasts for 2 weeks or less but may last for 1 month.</p> <p>c. <u>Ash fall from Mt. Etna</u> - Common occurrence anytime Mt. Etna erupts or emits an ash plume and the prevailing wind is from WSW.</p> <p>d. <u>NW'ly winds</u> - NW'ly Mistral winds occasionally reach the Port area during late winter/early spring. Their effect is limited to raising rough water in the Fleet Landing area. Associated weather is good in a typical event.</p>	<p>a. Small boat runs to/from the anchorages and Fleet Landing would be hazardous if not impossible to operate during a strong Gegante event. Small boat operations should be curtailed until winds and waves abate.</p> <p>b. Small boat runs to/from the N anchorage and Fleet Landing would be hazardous if not impossible to operate during a strong Scirocco event, and runs to/from the S anchorage may be hazardous. Small boat operations should be curtailed until winds and waves abate.</p> <p>c. Safe boating operations during an ash fall would be independent of the ash fall itself; it would be dependent on wind and wave conditions. WSW'ly flow would necessarily predominate from the surface to above 10,000 ft in order for the ash to reach the Port, so it would be unlikely that such an offshore flow would cause significant problems for small boats. Of greater concern would be the threat of ash contamination of the boat engines. Curtailment of small boat operations would be prudent until the ash fall ends. If operations are impossible to curtail, additional filtration of the air supply to the engines should be used. Air filters should be changed or cleaned often. Personnel should take precautions against accidental slipping on accommodation ladders and other surfaces. Visibility may be restricted during a powerful eruption.</p> <p>d. Because of their offshore component, the winds should not pose a safety hazard to small boats except in the vicinity of Fleet Landing where the wind is known to raise rough water. Likely the result of waves reflecting off the W face of the jetty/breakwater, the rough water could pose a threat to boats using Fleet Landing to embark/debark passengers.</p>	<p>a. Gegante winds are the likely result of a steep pressure gradient caused when high pressure is lying or building over Central Europe or the Balkans, and a low pressure system is over the Ionian Sea, North Africa near Libya/Tunisia, or transiting eastward south of Sicily. Prognostic charts should be reviewed with this scenario in mind.</p> <p>b. Scirocco winds are usually associated with a well-developed low pressure system over N Africa or the warm sector of a low pressure system located N of the Mediterranean Sea which transports the warm, moist air to Sicily. Scirocco winds are usually preceded by low clouds on the SE horizon about 12-24 hr prior to onset. Another indicator (used at Catania) is cumuloform clouds which form and stay over Mt. Etna during SE flow over N Sicily. Increasing S'ly winds at coastal stations along the NE coast of Libya indicate the start of a Scirocco. The following conditions indicate a strong Scirocco should be forecast: (1) an upper trough is present over the Balkans with a strong jet stream along its southern boundary; and (2) large pressure falls (after the diurnal pressure is removed) are observed at stations along the east coast of Tunisia. Weather associated with a Scirocco is largely dependent on both the length of the wind's overwater trajectory and the wind speed. High wind speeds and short overwater trajectories produce large amounts of dust that reduce visibilities, while low wind speeds and long overwater trajectories produce high humidities with fog and poor visibilities.</p> <p>c. Ash falls are possible whenever Mt. Etna emits an ash plume and prevailing winds are from WSW.</p> <p>d. An exceptionally strong Mistral outbreak from the Gulf of Lion across the W Mediterranean Sea may reach Taormina. Reviewed prognostic charts with this scenario in mind. Wave clouds on satellite imagery extending from Sardinia to Sicily are indicative of a gale force Mistral that extends SE into the Strait of Sicily. Consequently, such clouds also indicate the possibility of strong Mistral winds that may reach the E coast of Sicily near Taormina.</p>

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PORT VISIT INFORMATION

MAY 1988. NEPRF Meteorologists R. Fett and D. Perryman met with Mr. Pietro Ranieri, part-time pilot and local fisherman, to obtain much of the information included in this port evaluation.

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PORT VISIT INFORMATION

MAY 1988. NEPRF Meteorologists R. Fett and D. Perryman met with Mr. Pietro Ranieri, part-time pilot and local fisherman, to obtain much of the information included in this port evaluation.

APPENDIX A

General Purpose Oceanographic Information

This section provides some general definitions regarding waves and is extracted from H.O. Pub. No. 603, Practical Methods for Observing and Forecasting Ocean Waves (Pierson, Neumann, and James, 1955).

Definitions

Waves that are being generated by local winds are called "SEA". Waves that have traveled out of the generating area are known as "SWELL". Seas are chaotic in period, height and direction while swell approaches a simple sine wave pattern as its distance from the generating area increases. An in-between state exists for a few hundred miles outside the generating area and is a condition that reflects parts of both of the above definitions. In the Mediterranean area, because its fetches and open sea expanses are limited, SEA or IN- BETWEEN conditions will prevail. The "SIGNIFICANT WAVE HEIGHT" is defined as the average value of the heights of the one-third highest waves. PERIOD and WAVE LENGTH refer to the time between passage of, and distances between, two successive crests on the sea surface. The FREQUENCY is the reciprocal of the period ($f = 1/T$) therefore as the period increases the frequency decreases. Waves result from the transfer of energy from the wind to the sea surface. The area over which the wind blows is known as the FETCH, and the length of time that the wind has blown is the DURATION. The characteristics of waves (height, length, and period) depend on the duration, fetch, and velocity of the wind. There is a continuous generation of small short waves from the time the wind starts until it stops. With continual transfer of energy from the wind to the sea surface the waves grow with the older waves leading the growth and spreading the energy over a greater range of frequencies. Throughout the growth cycle a SPECTRUM of ocean waves is being developed.

A Beaufort Scale table with related wave effects is shown on the following page.

BEAUFORT SCALE

Beaufort Number	Wind Speed		Seaman's term	Effects observed at sea	Term and height of Waves in meters
	Knots	MPH			
0	Under 1	Under 1	Calm	Sea like mirror.	Calm, glassy, 0
1	1-3	1-3	Light air	Ripples with appearance of scales; no foam crests.	
2	4-6	4-7	Light breeze	Small wavelets; crests of glassy appearance, not breaking	Rippled, less than 0.5
3	7-10	8-12	Gentle breeze	Large wavelets; crests begin to break; scattered whitecaps.	Smooth, 0.5
4	11-16	13-18	Moderate breeze	Small waves, becoming longer; numerous whitecaps.	Slight, 1.0
5	17-21	19-24	Fresh breeze	Moderate waves, taking longer form; many whitecaps; some spray.	Moderate, 1.0-2.5
6	22-27	25-31	Strong breeze	Larger waves forming; whitecaps everywhere; more spray.	Rough, 2.5-4.0
7	28-33	32-38	Moderate gale	Sea heaps up; white foam from breaking waves begins to be blown up in streaks.	
8	34-40	39-46	Fresh gale	Moderate high waves; edges of crests begin to break; foam is blown in streaks.	
9	41-47	47-54	Strong gale	High waves; sea begins to roll; dense streaks of foam; spray may reduce visibility.	Very rough, 4.0-6.0
10	48-55	55-63	Whole gale	Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility reduced.	
11	56-63	64-72	Storm	Exceptionally high waves; sea covered with white foam patches; visibility still more reduced.	High, 6.0-9.0
12	64-71	73-82	Hurricane	Air filled with foam; sea completely white with driving spray; visibility greatly reduced. Winds of force 12 and above very rarely experienced on land; usually accompanied by widespread damage.	Very high, 9.0-13.5
13	72-80	83-92			
14	81-89	93-103			
15	90-99	104-114			
16	100-108	115-125			
17	109-118	126-136			

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